

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (Original) A semiconductor pressure sensor comprising:

a substrate comprising:

a first surface and a second surface opposite to the first surface;

a diaphragm formed in the substrate and arranged to be displaceable by a pressure medium acting on the first surface of the substrate; and

a sensor arranged on the second surface of the substrate to detect displacement of the diaphragm.

2. (Original) The semiconductor pressure sensor recited in claim 1, further comprising:

a support arranged adjacent to the second surface of the substrate;

wherein a portion of a first surface of the support is joined to the second surface of the substrate, and another portion of the first surface opposed to the sensor is offset from the sensor in a direction orthogonal to the first surface.

3. (Original) The semiconductor pressure sensor recited in claim 2, wherein the offset portion of the first surface of the support is formed by a recess in the support.

4. (Original) The semiconductor pressure sensor recited in claim 1, wherein the support is hermetically sealed to the substrate.

5. (Original) The semiconductor pressure sensor recited in claim 3, wherein the sensor is arranged between the diaphragm and the offset portion of the first surface of the support.

6. (Original) The semiconductor pressure sensor recited in claim 2, wherein the support includes a through-hole interconnection for outputting a signal from the sensor.

7. (Original) The semiconductor pressure sensor recited in claim 6, wherein the through-hole interconnection comprises:

a through-hole extending from the first surface of the support to a second surface of the support;

a conductive material filled in the through-hole; and

a conductive connector arranged on the second surface of the support and connected to the conductive material.

8. (Original) The semiconductor pressure sensor recited in claim 7, wherein the conductive connector comprises a bump.

9. (Original) The semiconductor pressure sensor recited in claim 7, wherein the conductive connector comprises a pad.

10. (Original) The semiconductor pressure sensor recited in claim 6, wherein the through-hole interconnection is electrically connected to a metal pad arranged between the substrate and the support.

11. (Original) The semiconductor pressure sensor recited in claim 10, wherein a diameter of metal pad arranged between the substrate and the support is greater than a diameter of the through-hole.

12. (Original) The semiconductor pressure sensor recited in claim 2, wherein the substrate includes a through-hole interconnection for outputting a signal from the sensor.

13. (Original) The semiconductor pressure sensor recited in claim 12, wherein the through-hole interconnection comprises:

a through-hole extending from the first surface of the substrate to the second surface of the substrate;

a conductive material filled in the through-hole; and

a conductive connector arranged on the first surface of the substrate and connected to the conductive material.

14. (Original) The semiconductor pressure sensor recited in claim 13, wherein the conductive connector comprises a bump.

15. (Original) The semiconductor pressure sensor recited in claim 13, wherein the conductive connector comprises a pad.

16. (Original) The semiconductor pressure sensor recited in claim 12, wherein the through-hole interconnection is electrically connected to a metal pad arranged between the substrate and the support.

17. (Original) The semiconductor pressure sensor recited in claim 16, wherein a diameter of metal pad arranged between the substrate and the support is greater than a diameter of the through-hole.

18. (Original) The semiconductor pressure sensor recited in claim 2, further comprising an insulation layer arranged between the substrate and the support.

19. (Original) The semiconductor pressure sensor recited in claim 2, further comprising a sealing metal arranged between the substrate and the support.

20. (Original) The semiconductor pressure sensor recited in claim 6, further comprising a sealing metal arranged between the substrate and the support,

wherein the sealing metal is arranged laterally outside the through-hole interconnection, relative to the sensor.

21. (Original) The semiconductor pressure sensor recited in claim 6, further comprising a sealing metal arranged between the substrate and the support,

wherein the sealing metal is arranged laterally inside the through-hole interconnection, relative to the sensor.

22. (Original) The semiconductor pressure sensor recited in claim 12, further comprising a sealing metal arranged between the substrate and the support,

wherein the sealing metal is arranged laterally outside the through-hole interconnection, relative to the sensor.

23. (Original) The semiconductor pressure sensor recited in claim 12, further comprising a sealing metal arranged between the substrate and the support,

wherein the sealing metal is arranged laterally inside the through-hole interconnection, relative to the sensor.

24. (Original) The semiconductor pressure sensor recited in claim 1, wherein the substrate comprises a silicon chip.

25. (Original) The semiconductor pressure sensor recited in claim 2, wherein the support comprises a glass support.

26. (Original) The semiconductor pressure sensor recited in claim 1, wherein the sensor comprises a piezo-resistive element.

27. (Original) The semiconductor pressure sensor recited in claim 1, wherein the substrate has a first thickness; and the diaphragm comprises a portion of the substrate that has a second thickness thinner than the first thickness.

28. (Original) The semiconductor pressure sensor recited in claim 2, wherein the offset portion of the first surface of the support and the second surface of the substrate define a space therebetween.

29. (Original) The semiconductor pressure sensor recited in claim 2, wherein the substrate and the support are joined together by anodic bonding.

30. (Original) The semiconductor pressure sensor recited in claim 2, wherein the substrate and the support are joined together by an adhesive layer arranged therebetween.

31. (Withdrawn) A semiconductor pressure sensor, comprising:
a support and a silicon chip joined to the support,

the silicon chip comprising: a diaphragm arranged to be displaceable under pressure applied to a first side of the silicon chip; and sensor circuitry arranged on a second side of the silicon chip, wherein:

the sensor circuitry comprises a piezo-resistive element having a resistance variable dependent upon displacement of the diaphragm; and

the second side of the silicon chip and the support are shaped to define a space therebetween.

32. (Withdrawn) The semiconductor pressure sensor of claim 31,
wherein the support has a through-hole for outputting a signal from the sensor circuitry.

33. (Withdrawn) The semiconductor pressure sensor of claim 31,
wherein the silicon chip has a through-hole for outputting a signal from the sensor circuitry.

34. (Withdrawn) The semiconductor pressure sensor of claim 31, wherein:
the support comprises a recess;
the second side of the silicon chip comprises an unetched flat surface; and
the recess and the flat surface define a space therebetween.

35. (Original) A method of forming a semiconductor pressure sensor comprising:
forming a silicon substrate comprising a first and second surface;

forming a diaphragm in the first surface of the substrate so that it is displaceable by a pressure medium acting on the first surface of the substrate; and

forming a sensor on the second surface of the silicon substrate to detect displacement of the diaphragm.

36. (Currently Amended) A method of forming a semiconductor pressure sensor as recited in claim 35, further comprising:

forming a glass support having a first and second surface;

forming a recess in the first surface of the glass;

joining the glass support to the silicon substrate so that the recess is arranged adjacent to the piezo-resistive element to form a space therebetween.

37. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the glass support is hermetically sealed to the silicon substrate.

38. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the step of forming the diaphragm in the silicon substrate is performed before the step of joining the glass support to the silicon substrate.

39. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the step of forming the diaphragm in the silicon substrate is performed after the step of joining the glass support to the silicon substrate.

40. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein a through hole is formed in the glass support, extending from the first surface to the second surface thereof.

41. (Original) A method of forming a semiconductor pressure sensor as recited in claim 40, wherein a conductive material is filled in the through hole, and a conductive connector is formed on the second surface of the glass support.

42. (Original) A method of forming a semiconductor pressure sensor as recited in claim 41, wherein the conductive connector comprises a bump.

43. (Original) A method of forming a semiconductor pressure sensor as recited in claim 41, wherein the conductive connector comprises a pad.

44. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein a through hole is formed in the silicon substrate, extending from the first surface to the second surface thereof.

45. (Original) A method of forming a semiconductor pressure sensor as recited in claim 44, wherein a conductive material is filled in the through hole, and a conductive connector is formed on the first surface of the silicon substrate.

46. (Original) A method of forming a semiconductor pressure sensor as recited in claim 45, wherein the conductive connector comprises a bump.

47. (Original) A method of forming a semiconductor pressure sensor as recited in claim 45, wherein the conductive connector comprises a pad.

48. A method of forming a semiconductor pressure sensor as recited in claim 35, further comprising forming an insulation film on the second surface of the silicon substrate.

49. (Original) A method of forming a semiconductor pressure sensor as recited in claim 48, further comprising forming an opening in the insulation film.

50. (Original) A method of forming a semiconductor pressure sensor as recited in claim 48, wherein the sensor is a piezo-resistive element formed beneath the insulation film.

51. (Original) A method of forming a semiconductor pressure sensor as recited in claim 48, further comprising forming a high-concentration lead part beneath the insulation film.

52. (Original) A method of forming a semiconductor pressure sensor as recited in claim 35, further comprising forming a metal pad and a sealing metal on the second surface of the silicon substrate.

53. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the glass support is joined to the silicon substrate by anodic bonding.

54. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the glass support is joined to the silicon substrate by an interposed adhesive layer.

55. (Original) A method of forming a semiconductor pressure sensor as recited in claim 40, further comprising:

forming a sealing metal on the second surface of the silicon substrate,
wherein the sealing metal is arranged laterally outside the through hole, relative to the sensor.

56. (Original) A method of forming a semiconductor pressure sensor as recited in claim 40, further comprising:

forming a sealing metal on the second surface of the silicon substrate,
wherein the sealing metal is arranged laterally inside the through hole, relative to the sensor.

57. (Original) A method of forming a semiconductor pressure sensor as recited in claim 44, further comprising:

forming a sealing metal on the second surface of the silicon substrate,

wherein the sealing metal is arranged laterally outside the through hole, relative to the sensor.

58. (Original) A method of forming a semiconductor pressure sensor as recited in claim 44, further comprising:

forming a sealing metal on the second surface of the silicon substrate,

wherein the sealing metal is arranged laterally inside the through hole, relative to the sensor.

59. (Original) A method of forming a semiconductor pressure sensor as recited in claim 36, wherein the sensor is arranged between the diaphragm and recess.

60. (New) The semiconductor pressure sensor of claim 12, wherein the substrate further comprises an outer insulation film formed on the first surface thereof and on inner walls of the through-hole.

61. (New) The semiconductor pressure sensor of claim 19, wherein the sealing metal is arranged along a periphery of the offset portion and forms a hermetic seal between the substrate and support.

62. (New) The semiconductor pressure sensor of claim 20, wherein the sealing metal is arranged along a periphery of the offset portion and forms a hermetic seal between the substrate and support.

63. (New) The semiconductor pressure sensor of claim 21, wherein the sealing metal is arranged along a periphery of the offset portion and forms a hermetic seal between the substrate and support.

64. (New) The semiconductor pressure sensor of claim 22, wherein the sealing metal is arranged along a periphery of the offset portion and forms a hermetic seal between the substrate and support.

65. (New) The semiconductor pressure sensor of claim 23, wherein the sealing metal is arranged along a periphery of the offset portion and forms a hermetic seal between the substrate and support.